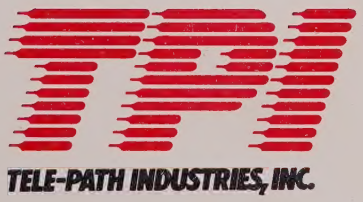
TELE-PATH INDUSTRIES
DIGITAL LOOP ANALYZER
MODEL 951
OPERATING MANUAL



TPIP 95_1
Issue # 2

TELE-PATH INDUSTRIES
DIGITAL LOOP ANALYZER
MODEL 95_1
OPERATING MANUAL

TELE-PATH INDUSTRIES, INC.

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SECTION I

INTRODUCTION

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1.1 GENERAL INFORMATION

The DIGITAL LOOP ANALYZER, TELE-PATH Model 95_1, is designed to perform Bit and Block Error testing of the local four wire loop in digital data networks offering traditional high speed Digital Data Services (DDS) and recent Basic Digital Services to verify the presence of a good circuit from the serving office to the customer premises.

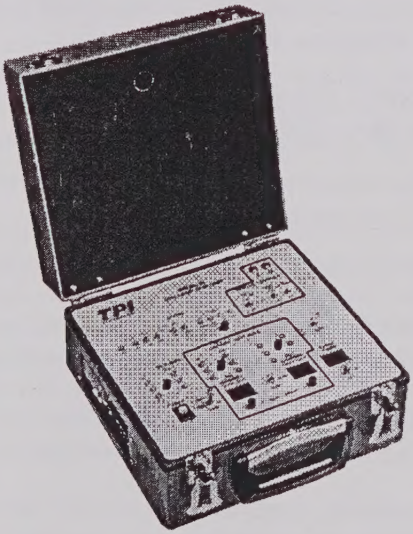


Figure 1-1. Top Cover Open View of the Digital Loop Analyzer

The Digital Loop Analyzer's ability to generate a Bit and Byte clock also allows it to accomplish end to end Digital Testing on four wire circuit segments. The Digital Loop Analyzer has the capability of testing both the Primary and Secondary Channels, independently, at data rates of 2.4, 4.8, 9.6, 19.2, 56, and 64 Kbps (There is no secondary channel at 64 Kbps).

1.1.1 DIGITAL NETWORK

Digital Data Networks are designed to provide highly reliable end-to-end digital service within the nation-wide telecommunications system. The first implementation of a digital network was not digital end-to-end, but had to make use of analog transmission systems for inter-city communications. Now, digital microwave radio and fiber optic transmission systems are available for long haul communications, making true end-to-end digital communications a reality.

There are two distinct advantages to transmitting data over a digital facility, as opposed to an analog facility:

1) Digital transmission is much less susceptible to noise, causing fewer errors.

2) Data can be transmitted at a much higher bit rate.

These two advantages are possible because transmission and reception of information in the digital format depends only on the detection of a pulse or no-pulse in a time slot, and does not look for variations in a sine wave to extract the information transmitted (as is the case in analog transmission).

Whether the customer chooses point-to-point service or multipoint, high quality transmission is provided and is safeguarded by stringent error rate and down-time objectives. Inherent with digital transmission systems such as DDS is the use of a highly accurate master timing supply to which an entire network is synchronized. Compatibility between networks must take into account the data format, timing signals, and the network control codes used in testing data facilities.

1.1.2 LOCAL LOOP

The DDS network, which is typical, can be engineered to meet individual customer needs, whether the customer is large or small. Typically, service consists of a digital facility that is terminated at each end by a local 4-wire loop. A Data Service Unit (DSU) and/or a Channel Service Unit (CSU) serves as the interface between the 4-wire local loop and the subscriber's Data Terminal Equipment (DTE). The DSU and CSU may be collocated in a single unit (referred to as a DSU), or they may be fabricated as separate pieces of equipment. In either case, the functions of the DSU/CSU remain the same. (The data sets, i.e. DSU/CSU, are referred to as Data Circuit-terminating Equipment, or DCE.)

On the central office end of the 4-wire local loop, an OCU (Office Channel Unit) serves as the interface between the loop and the channel bank equipment. The channel bank combines (via time division multiplexing) up to 24 voice and/or data channels into a single 1.544 Mbps bit stream (DS-1 format).

Figure 1-2 illustrates a typical digital network with local loops to customer terminals.

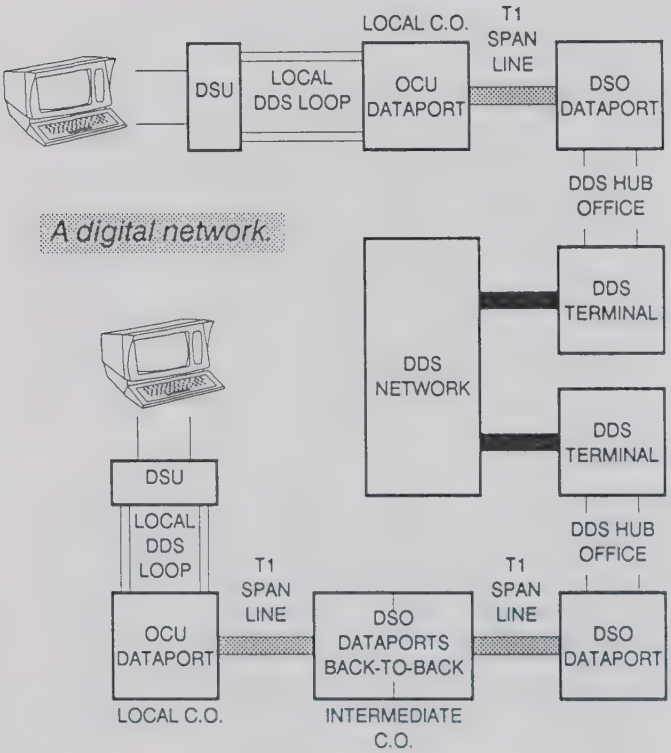


Figure 1-2

The signal format used to transmit data bits between the customer DTE and the DSU is Unipolar Pulses, while on the local loop the digital pulses are always Bipolar Return to Zero. The bit rate is customer optional to meet the rate requirements of their DTE. These "baseband" rates may be 2.4, 4.8, 9.6, 19.2, 56, or 64 Kbps.

There are several advantages of using bipolar pulses:

1) Cuts frequency response time in half. This allows a higher bit rate on a cable pair, doubling the information that can be sent by using unipolar pulses.

2) Reduces the D.C. component on the local facility by alternating positive and negative pulses. D.C. voltages affect some loop tests.

3) As an error detector - two successive pulses of the same polarity means that an error has occurred. (called a "Bipolar Violation")

4) For control and supervisory codes - for example, the codes that are used to remotely initiate and release the loopback on the DSU make use of bipolar violations.

1.1.3 DATA SERVICE UNIT

The primary purpose of the DSU is to work in conjunction with the CSU to provide CPE access to the digital network. The DSU performs these functions:

1) Accepts unipolar pulses from the CPE, converts them to bipolar, and sends them to the CSU.

2) Accepts bipolar pulses from the CSU, converts them to unipolar, and sends them to the CPE.

3) Performs the RT (Remote Terminal) loopback feature that opens the transmit and receive leads to the CPE as it loops the transmit and receive leads back to the CSU (network). The RT loopback may be initiated locally at the DSU, or remotely (at all customer rates except 64 Kbps).

1.1.4 CHANNEL SERVICE UNIT

The CSU performs three basic functions:

1) Accepts serial data in the bipolar format from the DSU and transmits it on the local loop to the serving central office.

2) Accepts serial, bipolar signals from the central office and transmits them to the DSU.

3) Provides a loopback feature which may be initiated locally, or remotely when the customer rate is not 64 Kbps. (Polarity of the simplex current on local loop controls the loopback function.)

1.1.5 OFFICE CHANNEL UNIT

The OCU (Office Channel Unit) performs 5 functions in serving as the link between the local loop and the serving central office:

1) Converts baseband data received from the local customer to the DSOA rate - 64 Kbps. The customer rate may be 2.4, 4.8, 9.6, 19.2, 56, or 64 Kbps. Except for 56 and 64 Kbps, this conversion is accomplished through the process called "Byte Stuffing." For 56 Kbps, service, the DSOA signal is created by adding one network control bit, bit 8, to every seven bits of customer data. The result is a 64 Kbps signal.

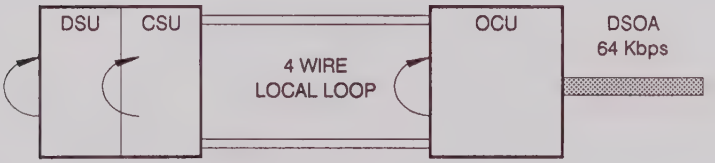
2) Decodes the 64 Kbps DSOA rate received from the network side and sends the proper rate to the local customer.

3) Performs line conditioning for the local loop (loss and bit speed conditioning).

4) Recognizes CSU loopback codes and performs the operations necessary to control the loopback functions, when not at the 64 Kbps customer rate.

5) Recognizes the OCU loopback code from the network side and places (or releases) the OCU in the loopback mode, when not at the 64 Kbps customer rate. The OCU loops back on the network side.

Access for performing digital tests on the OCU, local loop, and CSU/DSU is provided at the DSOA signal point. This access may be made by manually connecting a test set at the appropriate equipment location, or remotely through a SMAS (Switched Maintenance Access System) test point.



Curved arrows indicate where loopbacks are made.

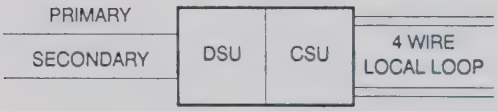
1.1.6 SECONDARY CHANNEL

OCU's, DSU's, and CSU's are available in the baseband rates 2.4, 4.8, 9.6, 19.2, 56 and 64 Kbps. Recent offerings are also equipped for Secondary Channel transmission for all baseband rates except 64 Kbps.

The Secondary Channel is a second transmission path, using the same facilities as primary transmission. Its purpose is to provide the customer with a channel over which network monitoring and diagnostic functions can be performed. The secondary channel operates at a much lower speed than the primary. For example, the secondary channel bandwidth available for 4.8 Kbps is 266.66 bps.

The secondary channel utilizes every third control bit for its transmission. On the local loop, secondary channel operation is accomplished by adding a leading bit (framing bit) and a trailing bit (control code and secondary channel data) to each 6 bits of primary channel data. In the 4.8 Kbps example, the local loop must be capable of transmitting at a 6.4 Kbps rate in order to handle the primary and secondary transmission.

SECONDARY CHANNEL OPERATION



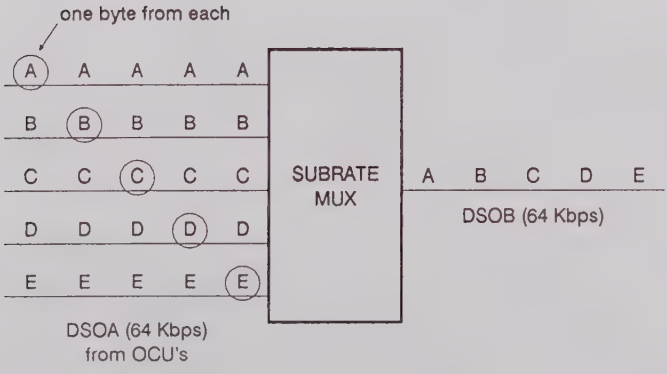
CHANNEL AND LOOP SPEED CALCULATIONS

PRIMARY CHANNEL	SECONDARY CHANNEL	LOOP SPEED
2400	133 1/3	3200
4800	266 2/3	6400
9600	533 1/3	12800
56000	2666 2/3	72000

1.1.7 DSOB SIGNALS

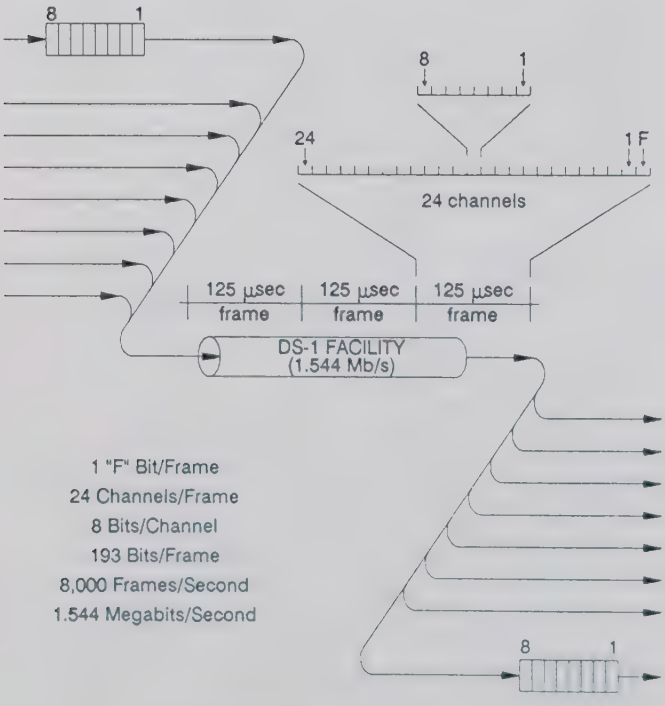
Within the telephone network, several subrate channels can be interleaved in the same 64 Kbps signal without loss of information by removing the redundancy in each DSOA signal. The resulting signal is called a "DSOB" signal. A single DSOB signal can carry up to five 9.6 Kbps customer channels, ten 4.8 Kbps channels, or twenty 2.4 Kbps channels. Unlike the DSOA signal, a fully utilized DSOB signal contains only a single copy of each network byte; successive network bytes contain data from different customers. A subrate framing pattern (shown below) is placed in the first bit position in order to allow the individual channels to be identified when the DSOB signal is demultiplexed.

SPEED	PATTERN (bit 1)
9.6	01100
4.8	01100 10100
2.4	01100 10100 11100 00100



1.1.8 DS-1

The next step in multiplexing is to combine, in channel bank equipment, the 64 Kbps signal with up to 23 other DSOB or DSOA signals to form a DS-1 formatted signal which runs at a bit rate of 1.544 Mb/s. This signal may then be transmitted on a T1 carrier facility, or multiplexed with other DS-1 signals to be transmitted on a facility capable of transmittiing at a higher bit rate. This facility might be digital microwave radio, coaxial cable, or light guide.



Data transmission through the network

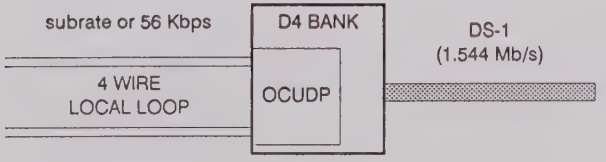
1.1.9 OCUDP

The alternative to converting the DSOA format to DSOB, before multiplexing to the 1.544 Mb/s rate, is the OCUDP. The customer baseband signal (2.4, 4.8, 9.6, 19.2, or 56 Kb/s) may be terminated in an OCU that is a part of the channel bank equipment. This type of OCU is referred to as an OCUDP, or Dataport Service. Byte stuffing occurs as in a standard OCU, but the DSOA signal is directly multiplexed into the DS-1 bit stream without going through the transformation to the DSOB format.

While this method does not provide us with the most efficient use of the facilities, it does give the customer virtually error free transmission through the network. This is possible because the receive end examines each bit pattern in the multiple copies of the bytes of the DSOA signal. Whatever bit pattern in the received bytes occurs the majority of times is taken as the actual customer transmission. The only way an error can be introduced in the bit stream is if the same errored bit is injected in the majority of the bytes that have been "stuffed." This process is referred to as "Majority-Vote" error correction.

For 56 and 64 Kbps service, the "Majority-Vote" error correction technique does not apply. Error correction can, however, be accomplished for 56 Kbps circuits by a different technique that employs two time slots on a DS-1 signal.

DATAPORT ARCHITECTURE



1.1.10 56 Kbps REPEATER

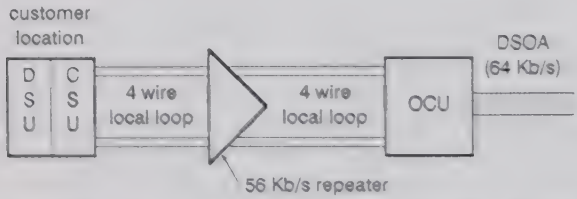
Since the transmission losses on 56 and 64 Kb/s local loops are much greater than for 2.4 - 19.2 Kb/s service, a 56 Kb/s regenerator must be used for long loops. Up to two 56 Kb/s regenerators may be used to extend a loop.

There are two types of 56 Kb/s regenerators:

1) central office

2) outside plant (manhole or pole mounted)

The 56 Kb/s regenerator is powered by simplex current fed from the OCU.



The regerator may be looped back by sending the proper bipolar violation code to the OCU, which reverses the polarity of the simplex current. This is the same process that is used to loop back the CSU, so caution must be observed when you are testing on a loop that includes a 56 Kb/s regenerator.

In order to make metallic loop tests (DC continuity, noise, and loss) from the central office to the customer location, the 56 Kb/s regenerator(s) must be bypassed. A discrete bipolar violation sent to the OCU will cause the simplex current to be removed from the local loop, engaging the bypass feature in the regenerator.

1.1.11 EIA INTERFACES

The EIA interface is the multi-lead connection between the CPE and Data Service Unit (DSU). The Electronic Industries Association (EIA) defines the function of each of the interface leads. The functions fall into 4 major categories:

1) Mechanical

2) Electrical

3) Functional

4) Procedural

Covered are such items as physical size and shape of connectors, wire size, voltage levels, bit rates, control functions, and the sequence in which events occur across the interface.

The Model 95 Digital Loop Analyzer is capable of operating with both the RS-232-C and the V.35 EIA interfaces. The Digital Loop Analyzer replaces the DSU on the interface to the DTE.

The V.35 interface is used for 56 and 64 Kb/s service. The pins (leads) are designated A through Z with G, I, O, and Q omitted, and AA through MM, with GG and II omitted. The chart below lists the function of the leads used in the V.35 EIA Interface.

LEAD DESIGNATION	INTERFACE CONNECTOR PIN*	CCIT NUMBER*	FUNCTION
AA	A	101	protective ground
AB	B	102	signal ground
CA	C	105	request to send
CB	D	106	clear to send
CC	E	107	data set ready
CD	H	108	data terminal ready
DF	F	109	rcv. line signal detector
BA(B)	P	103	transmit data (balanced)
BA(A)	S	103	transmit data (balanced)
BB(A)	R	104	receive data (balanced)
BB(B)	T	104	receive data (balanced)
DD(A)	V	115	rcv sig element timing (balanced)
DD(B)	X	115	rcv sig element timing
DB(A)	Y	114	xmt sig element timing
DB(B)	AA	114	xmt sig element timing (balanced)

* - Pin designation corresponds to CCIT V.35

The RS-232-C interface has 25 leads labeled 1 through 25, and is used with subrate digital service. An RS-232-C Primary Channel connector and a Secondary Channel interface connector are included on the Model 95 Digital Loop Analyzer for testing this service.

The table below lists the interface lead definitions.

PIN NUMBER	CIRCUIT	DESCRIPTION
1	AA	protective ground
2	BA	transmitted data
3	BB	received data
4	CA	request to send
5	CB	clear to send
6	CC	data set ready
7	AB	signal ground
8	CF	rcv line sig detector
9	–	(reserved for DSU testing)
10	–	(reserved for DSU testing)
11		unassigned
12	SCF	sec rcv line sig detector
13	SCB	sec clear to send
14	SBA	sec transmitted data
15	DB	xmt sig element timing (DCE source)
16	SBB	sec received data
17	DD	rcv sig element timing
18		unassigned
19	SCA	sec request to send
20	CD	data terminal ready
21	CG	sig quality detector
22	CE	ring detector
23	CH/CI	data sig rate selector (DTE/DCE source)
24	DA	xmt sig element timing
25		unassigned

1.2 PHYSICAL DESCRIPTION

The TPI Model 95_1 Digital Loop Analyzer shown below consists of circuit boards and a power supply housed in an aluminum case. It weighs 9 3/4 pounds and has external dimensions of 6 1/2 inches high, 10 3/4 inches wide, and 10 1/4 inches deep.

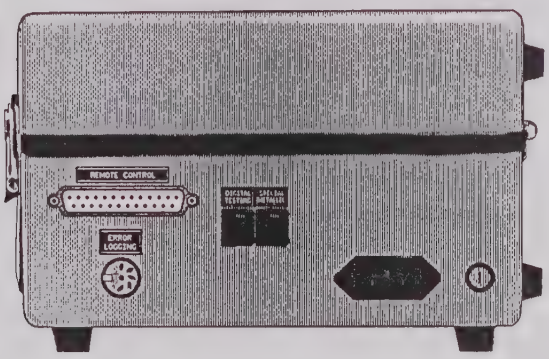
The power supply requirement is 105 to 129 volts at 50 to 70 Hertz and 26 Watts. It will operate satisfactorily over a temperature range of +40° to +120 °F and a relative humidity range of 20 to 95 percent.

An aluminum hinged cover attaches to the back of the unit to protect the control panel when the unit is being transported. The cover is secured by two front latches that snap loose and unhook.

A handle is attached to the front of the unit and is utilized to transport the Digital Loop Analyzer.

1.2.1 EXTERNAL CONNECTIONS

All external connections to the Model 95$_1$ Digital Loop Analyzer are made through jacks provided on the left and right sides of the case. The jacks on the right side of the case are for an 8-pin modular RJ-48 Telco jack ("DIGITAL TESTING"), a second Telco jack ("SPECIAL METALLIC") for metallic loop tests, an Error Logging Device jack, an RS-232 interface for use in remotely controlling the Digital Loop Analyzer, the power cord connector, and a fuse holder.

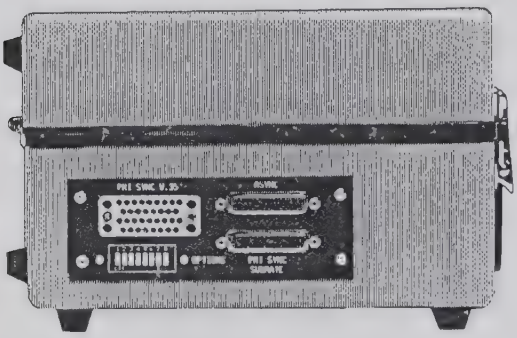


Most all testing will be done through connections to the "DIGITAL TESTING" modular jack.

The pin designations for the RJ-48 Telco interface are as follows:

PIN NUMBER	FUNCTION	PIN NUMBER	FUNCTION
1	R1	5	NOT USED
2	T1	6	NOT USED
3	NOT USED	7	T
4	NOT USED	8	R

The left side of the case houses the connectors for EIA interface (connections to the DTE), and the "OPTIONS" switch.



There are three connectors:

1) a V.35 Primary Channel synchronous 56 Kb/s female connector

2) an RS-232 Primary Channel synchronous subrate female connector

3) an RS-232 Secondary Channel asynchronous female connector

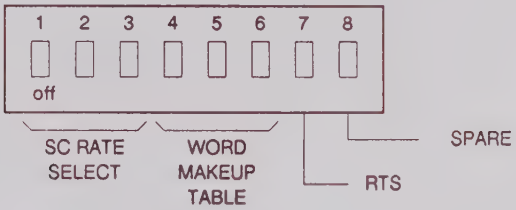
The "OPTIONS" switch is provided for:

1) Secondary Channel bit rate selections for Primary Channel rates

2) asynchronous word make-up on the Secondary Channel

3) operating mode options

This switch should be set with all positions "ON" for normal operation.



OPTION SWITCH

PRIMARY RATE SELECTED (KBPS)	ASYNCHRONOUS SECONDARY CHANNEL RATE (bps)	SWITCH POSITION (1)	(2)	(3)
2.4	75	ON	ON	ON
4.8	75	ON	ON	ON
	150	OFF	ON	ON
9.6	75	ON	ON	ON
	150	OFF	ON	ON
	300	OFF	OFF	ON
19.2	75	ON	ON	ON
	150	OFF	ON	ON
	300	OFF	OFF	ON
56	150	ON	ON	ON
	300	ON	OFF	ON
	1200	OFF	OFF	ON
56* SCRAMBLE	300	ON	ON	ON
	1200	ON	OFF	ON
	2400	OFF	OFF	OFF

Asynchronous Secondary Channel Rate Settings

*Point-to-point only

The Digital Loop Analyzer is capable of testing with any of the possible choices in the make-up of the asynchronous word, as given in the table below:

ASYNCHRONOUS WORD MAKE-UP	SWITCH POSITION 4	SWITCH POSITION 5	SWITCH POSITION 6
8 BITS, 1 STOP BIT, NO PARITY	ON	ON	ON
8 BITS, 2 STOP BITS, NO PARITY	ON	ON	OFF
8 BITS, 1 STOP BIT, PARITY	ON	OFF	ON
NOT USED	ON	OFF	OFF
7 BITS, 2 STOP BITS, NO PARITY	OFF	ON	ON
7 BITS, 1 STOP BIT, PARITY	OFF	ON	OFF
7 BITS, 2 STOP BITS, PARITY	OFF	OFF	ON
6 BITS, 2 STOP BITS, PARITY	OFF	OFF	OFF

Asynchronous word make-up

NOTE:

Since the Digital Loop Analyzer does not actually perform parity checking, it doesn't matter whether parity is even or odd. It is, however, important to know if the extra bit is present or not.

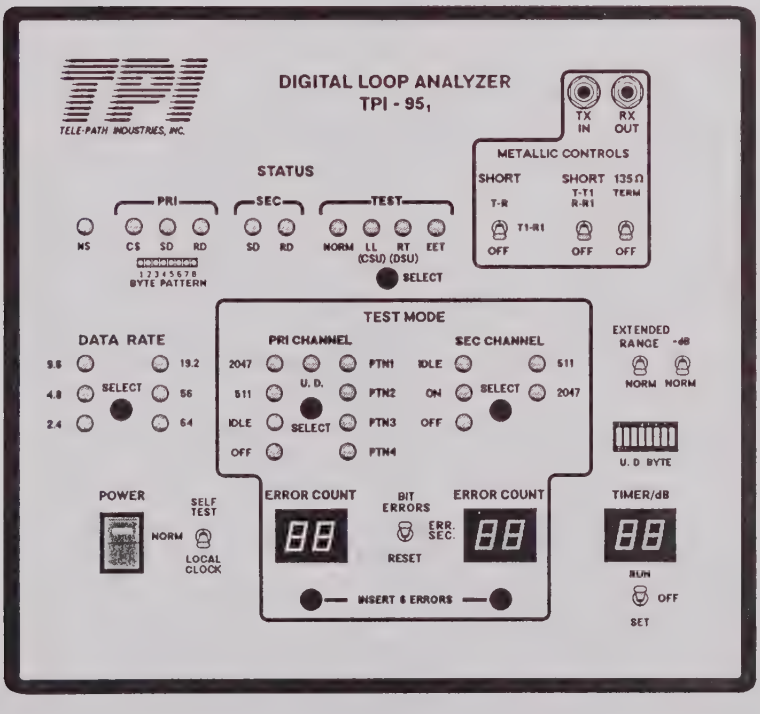
FUNCTION	SWITCH POSITION 7
RTS PERMANENTLY ON	ON
RTS CONTROLLED	OFF

Position 7 of the "OPTIONS" switch allows you to turn the Request to Send (RTS) lead permanently ON:

TABLE 1-3. Operating Modes

1.2.2 CONTROLS AND INDICATORS

The control panel contains switches to condition the unit, light-emitting diodes (LED's) as status indicators and as counters, and metallic controls.



A description of the controls, indicators, and counters is given below:

NS Indicator

This red LED extinguishes when access is gained to the local loop. In Primary Channel operation, this LED will illuminate when loss of line signal is detected, and will flash when receiving some network control codes, e.g. Abnormal Station Code (S0011110).

BYTE PATTERN Display

This group of 8 LED's shows the contents of the byte being received. A "1" in any position will cause the associated LED to light. Flickering or weakly lit LED's indicate that the value is alternating between "1" and "0".

Primary Channel Indicators

CS(Clear to Send) - Illuminates when primary DTE is clear-to-send.

SD(Send Data) - Illuminates when primary data is being transmitted.

RD(Receive Data) - Illuminates when primary data is being received.

Secondary Channel Indicators

SD(Send Data) - Illuminates when secondary data is being transmitted.

RD(Receive Data) - Illuminates when secondary data is being received.

Test Indicators

NORM	-	Illuminates when the unit is in a normal CSU/DSU mode, i.e., not LL, RT, or EET.
LL(CSU)	-	Illuminates when the unit is in local line loopback.
RT(DSU)	-	Illuminates when the unit is in remote terminal loopback.
EET	-	Illuminates when an end-to-end test is being conducted and is failing.

TEST Select

The TEST Select Pushbutton allows selection of the Test Modes described in the above Test Indicators paragraph, i.e. manual loopback testing. It is a pushbutton activated, LED indicating, step function device. Depressing the pushbutton selects the test/function.

METALLIC TESTING Aids

TX IN RX OUT	-	Mini-bantam jacks provided to allow access to the Transmit and Receive pairs for external test equipment [i.e., Tone Generator, Level Meters, etc.]
SHORT(T-R,T1-R1)	-	A three position switch that shorts either the T & R or the T1 & R1 conductors of the cable pairs to aid in loop resistance tests.

SHORT(T-T1/R-R1) - A two position switch that shorts the transmit and receive cable pairs simultaneously to aid in metallic testing.

135 OHM TERM. - A two position switch which places a 135 Ohm termination on the transmit and receive pairs for noise testing.

DATA RATE Select

The DATA RATE Switch is a pushbutton activated, LED indicating, step function device. Depressing the pushbutton selects the next highest data rate available.

PRI CHANNEL Select

The PRI CHANNEL Switch is a pushbutton activated, LED indicating, step function device. Depressing the pushbutton selects the next successive Primary Channel test/function.

For normal CSU/DSU operation, select "OFF". Selection of "IDLE" causes transmission of Idle Code in the primary channel. Any of the remaining selections will cause testing to be initiated; the error counter for the primary channel will then be activated.

Primary channel testing may be conducted with either 511 or 2047 pseudorandom words, any of four pattern sensitive sequences, or a user defined byte ("U.D."). The contents of the user defined byte are set via the "U.D.BYTE" DIP switch, located on the right side of the front panel. Conducting simultaneous testing (PRI & SEC) at the 56 Kbps data rate in either of the 511 or 2047 test mode selections will cause a quasi-random signal to be transmitted in the primary channel while a pseudorandom bit sequence (PRBS) is transmitted in the secondary channel. To select PRBS in both PRI & SEC channels simultaneously (CAUTION!!--This may introduce more zeros than allowed by the network), depress the primary channel 511 or 2047 test mode pushbutton a second time, which will cause the LED to flash.

SEC CHANNEL Select

The SEC CHANNEL Switch is a pushbutton activated, LED indicating, step function device. Depressing the pushbutton selects the next successive Secondary Channel test/function.

If the circuit is not optioned for Secondary Channel, this device must be in the "OFF" position. For normal CSU/DSU operation in a circuit optioned for Secondary Channel, select "ON".

NOTE:

If the primary channel is in the "OFF" state, you are not in a testing mode. Thus, the only valid selections for the secondary channel mode are "ON" and "OFF".

Selection of "IDLE" causes Idle Code to be transmitted in the secondary channel of a circuit with this capability. Selection of either 511 or 2047 causes testing to be initiated using either the 511 or 2047 pseudorandom words; the error counter for the secondary channel will then be activated.

EXT. RANGE Switch

With this switch in the "NORM" position, the Loop Test Unit will function on circuits with up to –34 dB of loss (approx.). With this switch in the "EXT. RANGE" position, the Loop Test Unit will function on circuits with up to –48 dB of loss (approx.) at the 56Kbps data rate. A marginal circuit might test good in "EXT. RANGE," but not in "NORM."

–dB Switch

This two position switch allows the test technician to place additional loss/stress on the Local Loop. The worst case result is approximately –3dB of additional loss on both transmit and receive. The intent of this feature is to allow the Local Loop to be tested with an increment of degradation amounting to less than 10%.

U.D. BYTE Switch

Used in conjunction with the "U.D." selection in the Primary Channel Test Mode, this DIP switch determines the contents of the byte to be transmitted.

POWER Switch

A rocker switch that illuminates an LED in the ON position.

CONFIGURATION Switch

This three position switch ("SELF TEST" position is momentary) allows the Digital Loop Analyzer to be configured in a SELF TEST or LOCAL CLOCK mode, when enabled.

The SELF TEST mode results in the Transmit and Receive (T-T1) (R-R1) cable pairs being shorted, and allows the Digital Loop Analyzer to be checked for proper operation.

The LOCAL CLOCK mode is utilized for end-to-end testing between two Digital Loop Analyzer's on point-to-point four wire loops. The LOCAL CLOCK position would be enabled on the Digital Loop Analyzer designated master, which would provide clock for the other Digital Loop Analyzer with the CONFIGURATION Switch set to NORMAL.

PRI CHANNEL ERROR COUNT Display

This two digit LED Display counts either Bit errors or Block errors (errored seconds) in the Primary Channel, depending on the position of the ERROR COUNT Switch. If the two digit capacity is exceeded, a period/decimal point will be illuminated. This display will be blank when no testing procedure is taking place in the primary channel.

BIT ERRORS/ERRORED SECONDS Switch

A two position, with momentary reset position, toggle switch to select the error counting mode.

SEC CHANNEL ERROR COUNT Display

This two digit LED Display that counts Bit errors or Block errors (errored seconds) in the Secondary Channel, depending on the position of the ERROR COUNT Switch. If the two digit capacity is exceeded, a period/decimal point will be illuminated. This display will be blank when no testing procedure is taking place in the secondary channel.

TIMER/dB

When a timed test is being conducted, this two digit display shows the time selected/remaining. Otherwise, it shows the amount of loss on the local loop, or ^{uu} if loss is too great (overflow).

NOTES:

The amount of loss shown is an approximation only. It is not intended for use as as primary dB measurement, but rather as an indicator of when further testing may be desired.

The timer's counter may be incremented in one minute intervals by moving the switch toward the "SET" position. When the desired amount of time is reached, movement of the switch to the "RUN" position will start the timed test. A period/decimal point will be illuminated to indicate a timed test in progress. At timeout, both ERROR COUNT Displays will lock the results and a second period/decimal point will be illuminated, and the display will resume operation as dB indicator (.X.X, where the X's are the digits representing the dB loss). To resume untimed operation, the switch MUST be moved back to the OFF position.

NOTE:

When time out has occurred, as denoted by the 2 decimals, the Digital Loop Analyzer is in a locked condition and will function only after moving the "EVENT TIMER" switch to "OFF".

INSERT SIX ERRORS

These pushbuttons, located under the PRIMARY and SECONDARY ERROR COUNT Displays, allow insertion of bit errors in groups of six on their respective channels.

1.3 FUNCTIONAL DESCRIPTION

1.3.1 APPLICATION

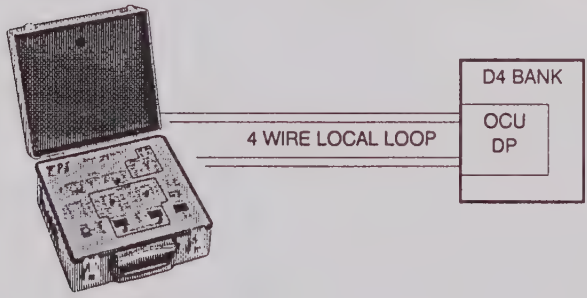
The Digital Loop Analyzer, TPI Model 95_1, is used to accomplish in-depth testing and analysis of digital circuits, including multipoint legs, from the customer premise to the serving central office. Its testing capabilities support data rates of 2.4, 4.8, 9.6, 19.2, 56, and 64 Kbps. The Digital Loop Analyzer has CSU/DSU functionality, can transmit and receive 511 or 2047 Pseudo-Random Bit Sequences (PRBS), 511 or 2047 Quasi-Random Signals (QRS), any of four pattern sensitive sequences, a user defined byte (U.D.), or idle code in the primary channel, and 511 or 2047 pseudorandom words or idle code in the secondary channel, and indicates bit or block errors on each channel. It includes independent channel control to support testing needs in multipoint service offerings. The Model 95_1 is compatible with embedded network test equipment. Loop loss confidence is enhanced by dB readout, and capability to place approximately 10% additional loss on the circuit. Supplemental controls are provided as metallic testing aids for shorting or placing a 135 Ω termination on the transmit and receive cable pairs. Capabilities include user-defined byte testing, received byte pattern indication, interface to TPI's Error Logging Device, and an RS-232 interface for remotely controlling the Digital Loop Analyzer.

Typical testing applications include:

Local Loop, four wire DDS

STRAIGHTAWAY - Digital Loop Analyzer to Network (Primary & Secondary Channel)
- Network to Digital Loop Analyzer (Primary & Secondary Channel)

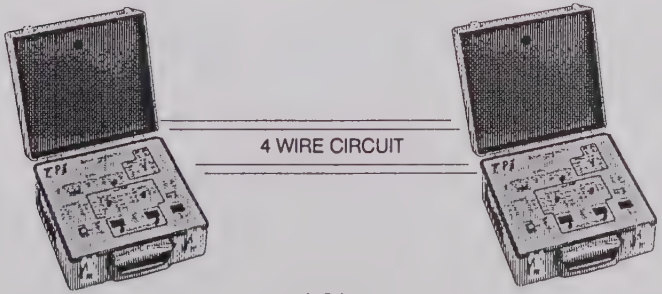
LOOPBACK - Network to Digital Loop Analyzer (Primary & Secondary Channel)



Four wire Digital Circuit

STRAIGHTAWAY - Digital Loop Analyzer to Digital Loop Analyzer

LOOPBACK - Digital Loop Analyzer to Digital Loop Analyzer Looped



1.3.2 SELF TEST

The Digital Loop Analyzer has a built-in Self Test feature. When the CONFIGURATION Switch (lower left) is held in the SELF TEST position, the Receive section is internally connected to the Transmit section in both Primary and Secondary Channels. To check for proper primary channel operation, the PRI CHANNEL TEST MODE selector should be moved to 511 or 2047 position, one of the four pattern sensitive positions, or the "U.D." position. Any data rate may be selected. Following a momentary transition, reset the counter and monitor to verify that they remain at "00". Errors may be injected for additional test confidence. Other Data Rates can also be selected to assure proper operation. Secondary channel operation may be checked in a similar fashion, simultaneously if desired.

A more extensive Self Test may be performed by first connecting the TELCO jack labeled "DIGITAL TESTING" to the TELCO jack labeled "SPECIAL METALLIC" using the cable that has modular plugs on both ends. Put the Configuration switch to the "LOCAL CLOCK" position, set the TEST MODE selectors as described above, and activate the Metallic Testing switch that is labeled "SHORT T-T1 R-R1." This will accomplish everything that the previously described Self Test procedure does, but will also test the cable being used, and the connections that it makes.

Another Self Test procedure may be performed in a similar fashion to the second Self Test, but with the TEST MODE selectors set to "OFF" and the CONFIGURATION switch set to "LOCAL CLOCK", using a Bit Error Rate Test (BERT) device connected to the DTE interface on the left side of the Digital Loop Analyzer. This procedure tests not only the internal circuitry of the Digital Loop Analyzer and the cable being used, but also tests the DTE interface itself.

1.3.3 MAINTENANCE

The only replaceable parts on the Digital Loop Analyzer are the line fuse and the external cords. The LED indicators and displays are soldered into the unit and are not field replaceable.

1.4 SPECIFICATIONS

TEST CAPABILITY

PRIMARY CHANNEL

XMT/RCV 511 OR 2047 PSEUDORANDOM WORDS
XMT/RCV 511 OR 2047 QRS at 56 Kbps DATA RATE
XMT/RCV FOUR PATTERN SENSITIVE SEQUENCES
XMT/RCV IDLE CODE

XMT/RCV USER-DEFINED BYTE

DISPLAY BIT ERRORS
DISPLAY ERRORED SECONDS

SECONDARY CHANNEL

XMT/RCV 511 OR 2047 PSEUDORANDOM WORDS
XMT/RCV IDLE CODE
DISPLAY BIT ERRORS
DISPLAY ERRORED SECONDS

SELF TEST

ERROR LOGGING DEVICE INTERFACE

LOCAL CLOCK/TEST GENERATION

REMOTE CONTROL

dB LOSS DISPLAY (+/– 3 dB)

–3 dB PLACEMENT

NETWORK CODE COMPATIBILITY

DSU LOOPBACK

CSU LOOPBACK

CSU LATCHING LOOPBACK

DSU LATCHING LOOPBACK (SEC. CHAN. CIRCUITS ONLY)

DATA RATES SUPPORTED

2.4, 4.8, 9.6, 19.2, 56, 64 Kbps

CONTROLS

DATA RATE

PRI CHANNEL TEST MODE (511/2047/IDLE/U.D./PTN-SN)

SEC CHANNEL TEST MODE (511/2047/IDLE)

–3 dB PLACEMENT

EXTENDED RANGE/NORMAL RANGE SELECTION

U.D. BYTE

POWER

SELF TEST/LOCAL CLOCK

BIT ERRORS/ERRORED SECONDS

SET TIMER

TEST

NORM
LL (CSU)
RT (DSU)
EET

METALLIC AIDS

SHORT
135 OHM TERMINATE
TX, RX JACKS

LINE INTERFACE

8 PIN MODULAR RJ-48 JACK (4 WIRE FULL DUPLEX)

DTE INTERFACE

SUB-RATE OPERATIONS: RS-232

56 AND 64 Kbps OPERATION: V.35

SEC CHANNEL OPERATIONS: RS-232

REMOTE CONTROL OPERATION: RS-232

INDICATORS

BYTE PATTERN

PRIMARY CHANNEL

CS = CLEAR TO SEND
SD = SEND DATA
RD = RECEIVE DATA

SECONDARY CHANNEL

SD = SEND DATA
RD = RECEIVE DATA

TEST

NORM = NON LL/RT/EET MODE
LL = LOCAL LINE LOOPBACK
RT = REMOTE TERMINAL LOOPBACK
EET = END-TO-END TEST (FAILURE)

POWER LED

PRI CHANNEL ERROR DISPLAY

SEC CHANNEL ERROR DISPLAY

EVENT TIMER/dB LOSS DISPLAY (+/– 3 dB)

NS = NO SIGNAL LED

POWER REQUIREMENTS

110 VAC INPUT

PHYSICAL

PORTABLE W/ HINGED LID

6 1/2"H x 10 3/4"W x 10 1/4"D

9 3/4 lbs.

SECTION II

USING THE MODEL 951 DIGITAL LOOP ANALYZER

2.1 TEST INFORMATION

The procedures described herein relate to testing of the four wire digital loop from the telephone company to the customer interface. DDS and Basic Digital Service are two examples of services that utilize digital local loops.

2.1.1 DIGITAL LOOP ANALYZER SET-UP

Open the top cover on the Digital Loop Analyzer by unsnapping and unlatching the two latches.

Insert the POWER cable into the side connector provided on the Loop Test Unit. Connect the other end of the grounded POWER cable to a 120 VAC power source. Move the POWER rocker switch on the control panel to the ON position. Verify that the POWER switch LED is lit, as well as a DATA RATE LED and the TIMER/dB display. If not, then

1) Check the fuse.

2) Conduct the SELF TEST procedure (Refer to paragraph 1.3.2) to determine if the Digital Loop Analyzer is operational.

On power-up, the TIMER/dB display will attempt to show the amount of loss on the circuit. If the Digital Loop Analyzer is not connected to the local loop, it will show ^{uu} (overflow). If connection has been made, but the front panel settings are incorrect for the circuit, the display will be unpredictable. Other LED's may be lit, depending on the position of various switches.

There are two cord sets provided for the network (TELCO) interface. One is a seven foot cable with 8-pin modular plugs at both ends. The other is a seven foot cable with an 8-pin modular plug at one end and color-coded alligator clips at the other end.

Below is a description of the color code:

T	White	R	Red
T1	Black	R1	Yellow

This table also appears on a label attached to this cord set.

The Digital Loop Analyzer has two 8-pin modular receptacles. The one labeled "DIGITAL TESTING" will be used for all test procedures except when access is desired for Metallic Test Assistance. The other 8-pin modular jack, also located on the right side of the Loop Test Unit, is labeled "SPECIAL METALLIC" and allows the four wires to be accessed, shorted, or terminated for assistance in Metallic Test Procedures.

Utilizing the appropriate cable for your application, connect the 8-pin modular plug to the 8-pin modular jack labeled "DIGITAL TESTING" on the right side of the Digital Loop Analyzer, and connect the other end to the TELCO interface.

The "NS" LED (No Signal) should not be illuminated (unless the network is transmitting all 0's). If it is illuminated, check the T, R, T1, & R1 connections.

All switches should be in the "NORMAL" or "OFF" position. The SECONDARY CHANNEL mode selector should be in the "OFF" position ONLY if the circuit is NOT optioned for Secondary Channel operation. Also, the "OPTIONS" switch, located on the left side of the unit, should have all switches set in the "ON" position for normal operation.

Connectors are provided on the left side of the Digital Loop Analyzer for DTE interface, where needed. These include Primary Channel subrate (RS-232-C), and 56 Kbps (V.35) synchronous connectors, and a Secondary Channel (RS-232-C) asynchronous connector. The OPTIONS switch is utilized to configure the Secondary Channel asynchronous interface.

2.1.2 TEST ACCESS

Network access for Digital Testing must be gained via one of the two TELCO interface cables. Once accomplished, the Digital Loop Analyzer is ready to be used to verify the presence of a good circuit from the serving central office to the demarcation point at the customer premise.

2.1.3 TYPES OF TESTS

The Digital Loop Analyzer allows independent test and control of the primary and secondary channels; one channel may be tested while the other channel is carrying Idle Code, or they may both be tested simultaneously.

The Digital Loop Analyzer has the capability to transmit and receive pseudorandom words of 511 or 2047 bits in the primary and secondary channel. At the 56 Kbps DATA RATE, the 511 or 2047 Quasi-Random (QRS) signal is used in the Primary Channel when conducting simultaneous testing.It can also transmit and receive four pattern sensitive sequences (see table below) or a user-defined byte in the primary channel. It can indicate bit or block errors on both primary and secondary channels for received pseudorandom words, pattern sensitive sequences, or user-defined bytes.

TEST	CONTENTS
PTN1	100 octets of all 1's, followed by 100 octets of all 0's
PTN2	100 octets of "01111110", and 100 octets of all 0's
PTN3	01001100 continuously repeated
PTN4	01000000 continuously repeated

The Digital Loop Analyzer is compatible with embedded network test equipment and allows straightaway testing with the 511 and 2047 pseudorandom words, 511 and 2047 quasi-random signals, pattern sensitive sequences, or user-defined bytes. Bit errors in groups of six can be inserted into the transmitted test word sequences.

The Digital Loop Analyzer is equipped with CSU and DSU loopback controls and indicators, as well as CSU and DSU latching loopback capability (DSU LLB in Sec. Chan. circuits only). Also, the Unit is equipped with features to assist in metallic testing.

NOTES:

If the circuit being tested is configured for secondary channel operation, the secondary channel must not be in the "OFF" state; the configuration of the Digital Loop Analyzer must reflect the configuration of the circuit.

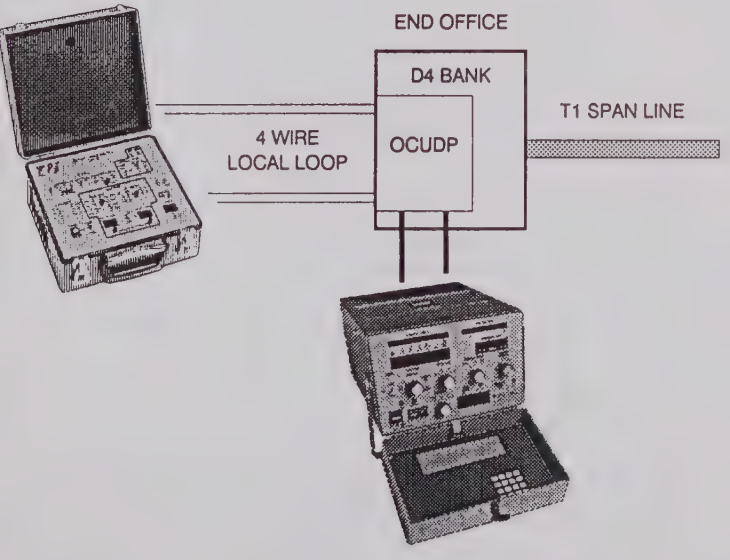
In order to conduct test/control procedures on either channel, the primary channel must not be in the "OFF" state. If you desire to test the secondary channel only, put the primary channel in the "IDLE" state.

2.2 TYPICAL APPLICATIONS

2.2.1 STRAIGHTAWAY TESTING, FOUR WIRE LOCAL LOOP

Straightaway Testing can be accomplished when access to a circuit is gained at two different points, e.g., the end of the local loop at the customer premise and at some point in the network. The Digital Loop Analyzer and the Network Test Equipment can each transmit, or transmit and receive simultaneously, a known test pattern toward the other. The data received by each is analyzed.

TYPICAL CIRCUIT



DIGITAL LOOP ANALYZER SETUP

Set up the cords as per Paragraph 2.1.1.

SWITCH SETUP (Digital Loop Analyzer)

NOTE:

All switches should be set to the NORMAL or OFF position, unless indicated otherwise below:

PRI CHANNEL TEST MODE selector	-	511, 2047, or one of the pattern sensitive sequences.
SEC CHANNEL TEST MODE selector	-	Should be "OFF" if the circuit is not optioned for Secondary Channel operation; if circuit has a secondary channel, 511 or 2047 may be selected for simultaneous testing in both channels, or set to "ON" for primary channel testing only.
ERRORS switch	-	Bit Errors or Errored Seconds
DATA RATE selector	-	Rate on Subscriber card
POWER switch	-	On

PROCEDURE FOR PRIMARY CHANNEL TESTING

NOTE:

This example refers to cooperative testing with TPI's Data Test Unit Model 108/109 RT II as the Network Data Test Unit at the near end OCUDP (setup must be consistent with the Digital Loop Analyzer's setup).

ACTION - Connect the Data Test Unit Signal and Clock leads to a D4 Channel Bank via the appropriate OCU Dataport Card and timing source. On the Data Test Unit, initiate the appropriate test/control procedure.

RESPONSE - The PRIMARY CHANNEL ERROR COUNTER on the Digital Loop Analyzer and the ERROR COUNTER on the Data Test Unit should lock. Reset both counters. They should hold at zero.

ACTION - Errors may be inserted in either direction. For example, depress the "INSERT 6 ERRORS" Pushbutton on the Digital Loop Analyzer once.

RESPONSE - The Network Data Test Unit's error count will display 6 bit errors.

ACTION - Depress the "ALL 1's" Pushbutton on the Network Data Test Unit.

RESPONSE - The Digital Loop Analyzer's ERROR COUNT display will indicate errors.

PROCEDURE FOR SECONDARY CHANNEL TESTING

ACTION - Set up the Network Data Test Unit for Secondary Channel, 511 or 2047 pseudorandom word Transmit & Receive Testing. (e.g., KEYPAD 5, 3, 1)

RESPONSE - The Digital Loop Analyzer's SECONDARY CHANNEL ERROR COUNTER will lock and the Network Data Test Unit Keypad display will indicate zero S.C. errors and zero Block errors. Reset the Digital Loop Analyzer's ERROR COUNTERS.

ACTION - Errors may be inserted in either direction. For example, depress the Digital Loop Analyzer's "INSERT 6 ERRORS" Pushbutton once.

RESPONSE - The Network Data Test Unit's Keypad Display will indicate 6 S.C. errors and typically 1 Block error.

ACTION - Change a switch setting on the Network Data Test Unit, e.g., temporarily move the INPUT/OUTPUT switch.

RESPONSE - The Digital Loop Analyzer's SECONDARY CHANNEL ERROR COUNT will display errors.

NOTE:

With recent versions of TPI's 108/109 RT II Data Test Unit, both channels may be tested simultaneously by setting up both the front panel switch settings and the keypad procedures.

NOTES:

If the circuit being tested is configured for secondary channel operation, the secondary channel must not be in the "OFF" state; the configuration of the Digital Loop Analyzer must reflect the configuration of the circuit being tested.

In order to conduct test/control procedures on either channel, the primary channel must not be in the "OFF" state. If you desire to test the secondary channel only, put the primary channel in the "IDLE" state.

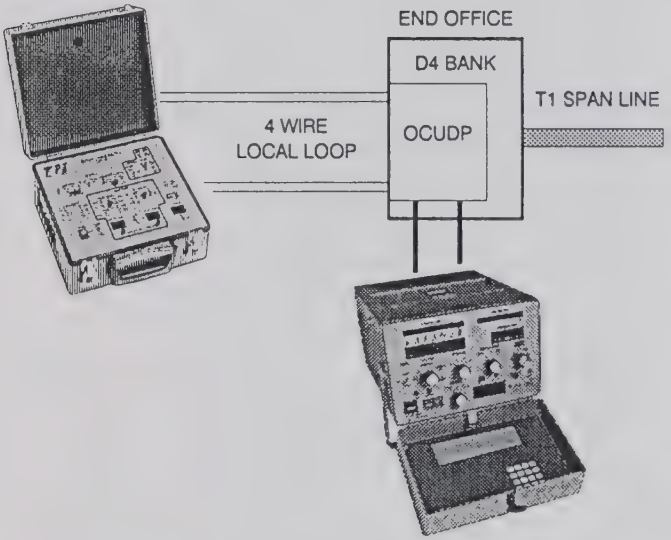
2.2.2 LOOPBACK TO NETWORK

NOTE:

DSU latching loopback capability is available only whith circuits optioned for Secondary Channel operation.

The Digital Loop Analyzer has the capability to establish local (CSU) and remote (DSU) Loopbacks to allow Network Test Equipment to perform Loopback confidence testing on the 4WLL.

TYPICAL CIRCUIT



DIGITAL LOOP ANALYZER SETUP

Set up the cords per Paragraph 2.1.1.

SWITCH SETUP

NOTE:

All switches should be set to the NORMAL or OFF position, unless indicated otherwise:

DATA RATE selector	-	Rate on Subscriber card
ERROR switch	-	Bit Errors
POWER switch	-	On
SEC CHANNEL TEST MODE selector	-	Should be "ON" ONLY if the circuit is optioned for Sec. Chan. operation. If there is no Sec. Chan., set this to "OFF". Since the Pri. Chan. is "OFF", the only valid choices for the Sec. Chan. mode selector are "ON" and "OFF".

PROCEDURE

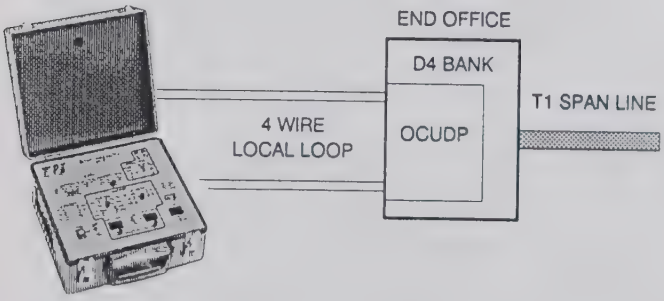
ACTION	-	Initiate a CSU Loopback Test from the Network Data Test Unit.
RESPONSE	-	On the Digital Loop Analyzer, the "LL" LED will illuminate, to indicate a successful CSU (LL) Loopback. On the Network Data Test Unit, the counter should lock and allow either Bit or Block Error Testing.
ACTION	-	Initiate a DSU Loopback from the Network Test Unit.

RESPONSE - On the Digital Loop Analyzer, the "RT" LED will illuminate, to indicate a successful DSU (RT) Loopback. On the Network Data Test Unit, the counter should lock and allow either Bit or Block Error Testing.

2.2.3 LOOPBACK TO LOCAL LOOP

The Digital Loop Analyzer can conduct either Bit Error or Block Error (Errored Second) testing on the Local Loop when a hard loop is placed on the OCU Dataport Card. These tests can be accomplished on Secondary Channel optioned circuits or on Primary Channel only circuits.

TYPICAL CIRCUIT



DIGITAL LOOP ANALYZER SETUP

Set up the cords per Paragraph 2.1.1.

SWITCH SETUP

NOTE:

All switches should be set to the NORMAL or OFF position, unless indicated otherwise below:

DATA RATE selector	-	Rate on Subscriber card
PRI CHANNEL TEST MODE selector	-	511, 2047, U.D., or one of the pattern sensitive sequences. If U.D. is selected, also set the U.D. BYTE DIP switch for the desired byte pattern.
SEC CHANNEL TEST MODE selector	-	Should be "OFF" if the circuit is not optioned for Secondary Channel operation; if circuit has a secondary channel, 511 or 2047 may be selected for simultaneous testing, or set to "ON" for primary channel testing only.
ERROR switch	-	Bit Errors or Errored Seconds
POWER switch	-	On

PROCEDURE

ACTION - Verify that a hard loop has been placed on the OCU Dataport card.

RESPONSE - The PRIMARY CHANNEL ERROR COUNT on the Digital Loop Analyzer will lock. Reset the counter and it should read and hold "00".

ACTION - Errors may be inserted. Depress the "INSERT 6 ERRORS" Pushbutton on the Digital Loop Analyzer.

RESPONSE - The Digital Loop Analyzer's PRIMARY CHANNEL ERROR COUNT Display will indicate 6 Bit errors, or typically one Block error.

NOTES:

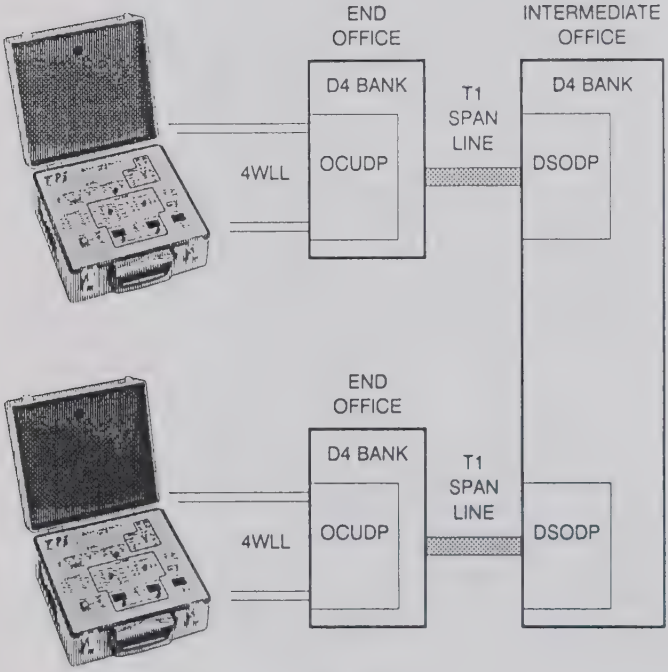
If the circuit being tested is configured for secondary channel operation, the secondary channel must not be in the "OFF" state; the configuration of the Digital Loop Analyzer must reflect the configuration of the circuit being tested.

In order to conduct test/control procedures on either channel, the primary channel must not be in the "OFF" state. If you desire to test the secondary channel only, put the primary channel in the "IDLE" state.

2.2.4 END TO END TESTING – NETWORK

The Digital Loop Analyzer has the capability to accomplish Bit Error or Block Error (Errored Second) cooperative testing (customer premise to customer premise). These tests can be conducted on Secondary Channel optioned circuits or Primary Channel only circuits. These end-to-end tests require the use of two Digital Loop Analyzers. Both straightaway and manual loopback type testing can be conducted.

TYPICAL CIRCUIT



DIGITAL LOOP ANALYZER SETUP-Manual Loopback

NOTE:

All switches should be set to the NORMAL or OFF position, unless indicated otherwise below:

DATA RATE switch - Rate on Subscriber card

PRI CHANNEL TEST MODE selector	-	511, 2047, U.D., or one of the pattern sensitive sequences. If U.D. is selected, also set the U.D. BYTE DIP switch for the desired byte pattern.
SEC CHANNEL TEST MODE selector	-	Should be "OFF" if the circuit is not optioned for Secondary Channel operation; if circuit has a secondary channel, 511 or 2047 may be selected for simultaneous testing in both channels, or set to "ON" for primary channel testing only.
ERROR switch	-	Bit Errors or Errored Seconds
POWER switch	-	On

PROCEDURE

The Digital Loop Analyzer may be used in a cooperative manner with another Digital Loop Analyzer at another customer premise in a Straightaway Test, similar to the Paragraph 2.2.1 procedure, except that network test equipment is not involved. Counters should lock, be resetable, and hold "00".

In order to use the Digital Loop Analyzers in a manual Loopback Test, the following steps would be followed:

ACTION	-	Select the "LL" Local Line Mode on one of the Digital Loop Analyzers. (call it "Control")

RESPONSE - This will provide a loop toward the other Digital Loop Analyzer (call it "Test"), and will cause its ERROR COUNT Display(s) to lock. From the "Test" Digital Loop Analyzer, errors may be inserted after resetting the counters.

NOTES:

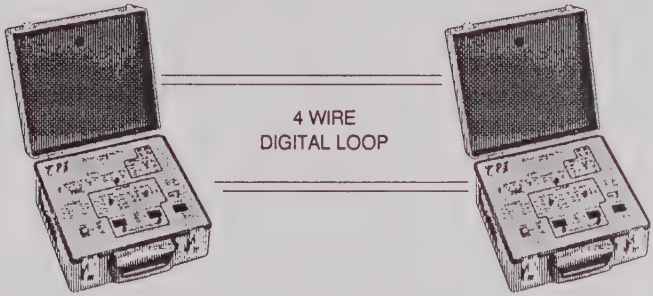
If the circuit being tested is configured for secondary channel operation, the secondary channel must not be in the "OFF" state; the configuration of the Digital Loop Analyzer must reflect the configuration of the circuit being tested.

In order to conduct test/control procedures on either channel, the primary channel must not be in the "OFF" state. If you desire to test the secondary channel only, put the primary channel in the "IDLE" state.

2.2.5 END TO END TESTING, FOUR WIRE DIGITAL LOOP

The Digital Loop Analyzer also has the capability to accomplish Bit Error or Block Error (Errored Second) cooperative testing from one customer premise to another customer premise, without a network between the two customer premises. These tests can be conducted in a similar fashion to paragraph 2.2.4, also requiring the use of two units.

TYPICAL CIRCUIT



DIGITAL LOOP ANALYZER SETUP-Manual Loopback

NOTE:

All switches should be set to the NORMAL or OFF position, unless indicated otherwise below:

DATA RATE selector	-	Circuit rate
ERROR switch	-	Bit Errors
CONFIGURATION switch	-	Local Clock (control unit)
POWER switch	-	On
PRI CHANNEL TEST MODE selector	-	511, 2047, U.D., or one of the pattern sensitive sequences. If U.D. is selected, also set the U.D. BYTE DIP switch for the desired byte pattern.

SEC CHANNEL TEST MODE selector - Should be "OFF" if the circuit is not optioned for Secondary Channel operation; if circuit has a secondary channel, 511 or 2047 may be selected for simultaneous testing in both channels, or set to "ON" for primary channel testing only.

PROCEDURE

The Digital Loop Analyzer may be used in a cooperative manner with another Digital Loop Analyzer at another customer premise in a Straightaway Test similar to the paragraph 2.2.1 procedure. In this case, the primary channel mode selector can be set to either 511, 2047, U.D., or any of the pattern sensitive sequences on both units. The secondary channel mode selector may be set to either 511 or 2047 to test the secondary channel simultaneously.

NOTE:

The use of a secondary channel on a circuit will overspeed the local loop's overall rate of data transmission; possible problems are more likely to show up now if you test the circuit as if it had a secondary channel, whether it eventually will have one or not.

The Digital Loop Analyzers may also be used in a pass/fail manual loopback test, similar to the paragraph 2.2.4 procedure. In this case, the primary channel test mode selector is set to "OFF" on both units, and the secondary channel test selector is set to either "OFF" or "ON" on both units (since the primary channel mode selector is in the "OFF" state, the only valid settings for the secondary channel mode ar "OFF" and "ON"). The TEST Select button on the "control" unit would be used to select "EET", with the test selected on the "test" unit being "NORMAL". Upon initiating the test, the "EET" LED on the "control" unit will illuminate, then extinguish (If it doesn't extinguish, the test fails). The "RT" LED will flash on the "test" unit.

NOTE:

The manual END-TO-END Test is pass/fail, and no actual error count is produced. If an error count is desired, please refer to the previous END-TO-END Testing procedure.

2.3 TIMED TEST

Any one of the tests discussed can be a timed test by utilizing the EVENT TIMER on the Digital Loop Analyzer.

PROCEDURE

ACTION - Move the toggle switch to the SET position.

RESPONSE - The "TIMER/dB" display will show the timer's current setting.
- The "TIMER/dB" display will increment in one minute intervals for each movement of the toggle switch to the SET position.

ACTION - Move the toggle switch to the RUN position when the desired time is set.

RESPONSE - A period/decimal point will be illuminated with the time set on the EVENT TIMER Display. At timeout, a second period/decimal point will be illuminated, and the display will again show the dB loss (i.e. .X.X, where the X's represent the loss). Additionally, both ERROR COUNT Displays will lock at timeout.

NOTE

If the switch is left in the RUN position with the time selected, and a timed test has concluded, two decimals will appear in the EVENT TIMER display. The Digital Loop Analyzer will not function until the EVENT TIMER switch is moved to either the OFF position or the SET position.

2.4 METALLIC TESTING AIDS

If the 8-Pin Modular TELCO Jack marked Metallic is utilized, the following Aids may be used in conducting Metallic Testing:

- A toggle switch on the Digital Loop Analyzer may be used to short the cable pairs either T to R or T1 to R1.
- A toggle switch on the Digital Loop Analyzer may be used to short Transmit & Receive cable pairs, shorting T to T1 and R to R1 simultaneously.
- A toggle switch on the Digital Loop Analyzer may be used to place a 135 Ω termination on the Transmit & Receive cable pairs.
- Two mini-bantam jacks on the Digital Loop Analyzer may be used for Transmit and Receive Metallic access.

T, R, T1, and R1are identified by color code on the universal interface cord.

2.5 TROUBLESHOOTING

PROBLEM	SOLUTION
Displays will not light	- TEST selector is in either "LL" or "RT" loopback mode. This contition may have been initiated manually, or by the network.
	- For either error counter display to light and show an error count, the primary channel mode must be either 511, 2047, U.D., or one of the pattern sensitive sequences.
	- For the secondary channel error count display to light and show an error count, the secondary channel mode must be either 511 or 2047.
"NS" LED is lit	- Indicates "no signal", or all 0's being received. Check the cord connections.
	- The network may be transmitting all 0's if there is nothing connected to the network side of the OCU. (If there is nothing connected to the network side of the OCU, the data that it will transmit on the local loop will vary with the OCU's manufacturer.

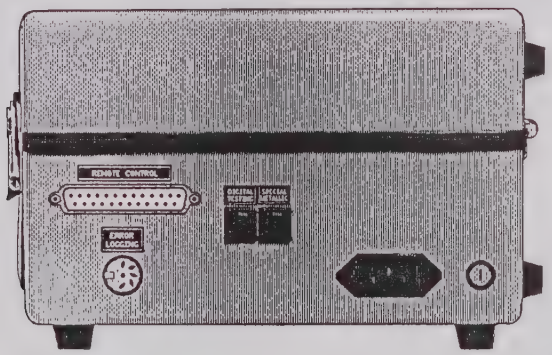
PROBLEM	-	SOLUTION
"NS" LED is flashing	-	Network is transmitting control codes; may indicate that there is nothing connected to the OCU.
Two decimal points are lit on the "TIMER/dB" display, and the error counters are locked up	-	A timed test was conducted, and has terminated. Please refer to section 2.3.
TIMER/dB display shows (uu)	-	Digital Loop Analyzer is attempting to measure the loss on the local loop, but the amount of loss is too great for this measurement to be displayed (overflow).

SECTION III

REMOTE CONTROL

3.1 GENERAL INFORMATION

The TPI Model 95_1 Digital Loop Analyzer's remote control feature permits test/control procedures to be executed from a remote terminal. Connection is made via the RS-232 connector on the right side of the unit (see below).



The Model 95_1 will recognize only upper-case letters; please be sure that your CAPS LOCK key is activated.

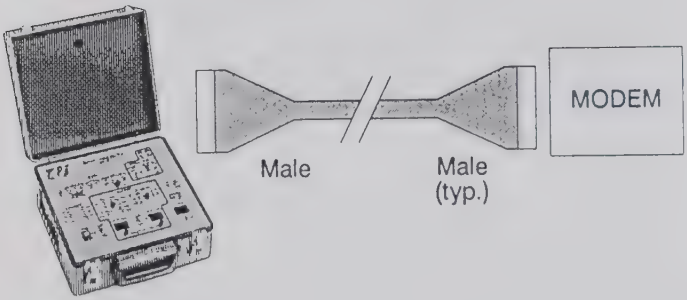
When a test/control procedure is being conducted, many of the Digital Loop Analyzer's front panel settings are over-ridden. Control reverts to the front panel upon termination of the test/control procedure.

3.1.1 CONNECTION

Communication parameters are pre-set:

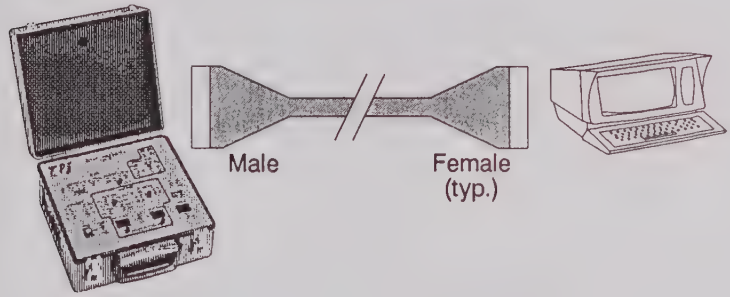
1200 Baud
Even parity
7 data bits/word
1 stop bit

The following illustrates the Digital Loop Analyzer connected to a modem:



1	protective ground	protective ground	1
2	transmitted data	transmitted data	2
3	received data	received data	3
4	request to send	request to send	4
7	signal ground	signal ground	7
20	data terminal ready	data terminal ready	20

The following illustrates the Digital Loop Analyzer connected directly to a terminal:



1	protective ground	protective ground	1
2	transmitted data	transmitted data	2
3	received data	received data	3
4	request to send	request to send	4
7	signal ground	signal ground	7
20	data terminal ready	data terminal ready	20

3.2 OPERATION

The test/control procedures described in SECTION II may also be performed via remote control.

When the Digital Loop Analyzer is available for remotely controlled operation, the following prompt will be displayed:

```
>
```

If the Digital Loop Analyzer does not recognize part of a command, the following will result:

```
?
>
```

The Digital Loop Analyzer is now ready for you to try again.

3.2.1 LOOPBACKS

The following is a description of the loopback features available via remote control:

LL - Establishes an "LL" (CSU) loopback toward the network at the Digital Loop Analyzer.

RT - Establishes an "RT" (DSU) loopback toward the network at the Digital Loop Analyzer.

N - Cancels previous loopback.

After entering any of the previous commands, the Digital Loop Analyzer will respond with "OK".

3.2.2 TESTING

When a test is in progress, you will receive an error report after the first 10 seconds (approximately). This report is updated approximately every 5 seconds, until testing is terminated.

The proper format for testing commands is as follows:

> [DATA RATE],[PRI. CHAN. MODE],[SEC. CHAN. MODE]

NOTE:

The three parameters must all appear in the command line, and they must be separated by commas.

The only exception to this is that at the 64 Kbps data rate, there is no secondary channel; only the first two parameters will appear.

The valid data rates are 2.4, 4.8, 9.6, 19.2, 56, and 64.

The valid primary channel modes are:

`OFF` - Digital Loop Analyzer functions as a CSU/DSU. No error counts are produced in either channel.

`I` - Digital Loop Analyzer transmits IDLE CODE in the primary channel. No error count is produced in the primary channel.

`511` - Digital Loop Analyzer transmits the 511 pseudo-random word test in the primary channel, and interprets data received. A primary channel error count is produced in this mode.

2047 - Digital Loop Analyzer transmits the 2047 pseudo-random word test in the primary channel, and interprets data received. A primary channel error count is produced in this mode.

P1 - Digital Loop Analyzer transmits the first pattern sensitive sequence in the primary channel, 100 octets of all 1's followed by 100 octets of all 0's. A primary channel error count is produced in this mode.

P2 - Digital Loop Analyzer transmits the second pattern sensitive sequence in the primary channel, 100 octets of "01111110" followed by 100 octets of all 0's. A primary channel error count is produced in this mode.

P3 - Digital Loop Analyzer continuously transmits "01001100". A primary channel error count is produced in this mode.

P4 - Digital Loop Analyzer continuously transmits "01000000". A primary channel error count is produced in this mode.

The valid secondary channel modes are:

OFF - This setting is used to tell the Digital Loop Analyzer that the circuit being tested does not have a secondary channel. Use this setting only if the circuit does not have a secondary channel.

I - Digital Loop Analyzer transmits IDLE CODE in the secondary channel. No error count is produced in the secondary channel.

511 - Digital Loop Analyzer transmits the 511 pseudo-random word test in the secondary channel, and interprets data received. A secondary channel error count is produced in this mode. (This is only a valid selection when the primary channel mode is not "OFF".)

2047 - Digital Loop Analyzer transmits the 2047 pseudo-random word test in the secondary channel, and interprets data received. A secondary channel error count is produced in this mode. (This is only a valid selection when the primary channel mode is not "OFF".)

After the first error report, errors may be inserted.

IP - Inserts 6 bit errors into primary channel.

IS - Inserts 6 bit errors into secondary channel.

A report of the amount of loss on the local loop may be requested at any time:

DB - Reports amount of loss on the local loop, in dB, or displays "OVF" (overflow) if there is too much loss for the Digital Loop Analyzer to measure.

NOTE:

The dB loss report is not an exact measurement, but an indication of whether further testing may be desirable.

To terminate testing:

T - Terminate testing.

3.3 EXAMPLE

Below is a sample session producing error reports from simultaneous primary and secondary channel testing:

```
4.8,P1,2047
Beginning test...
>PE=000   SE=000
>PE=001   SE=000
>IP
>PE=007   SE=000
>DB
DB=09
>T
>PE=007   SE=000
>
```

The first line represents what you would type into the terminal to initiate testing. In this example, the circuit being tested has a data rate of 4.8 Kbps, and has a secondary channel. The primary channel test that was selected was "P1", or the first pattern sensitive test. The secondary channel test, being executed concurrently with the primary channel test, is the "2", or 2047 pseudo-random word test.

After approximately five seconds, the first error report showed no bit errors in either channel.

After another five sec. interval, the second error report showed one bit error in the primary channel, with no bit errors in the secondary channel.

The next line shows the user inserting 6 bit errors into the primary channel.

The following line, which was displayed approximately 5 sec. after the previous error report, reflects the bit error counts that resulted from the bit error insertion. Please note that the numbers represent the total number of bit errors that occurred on each channel since the test was initialized, and not the number of bit errors since the last report.

The user then requested a report of the approximate amount of loss on the local loop.

NOTE:

The dB loss report will not furnish an exact measurement, only an approximation to indicate when further testing may be desirable.

The next line shows the results of this request; there was approximately –9 dB of loss on the local loop

The user then terminated the test session, by entering a "T".

NOTE:

For 56 Kbps simultaneous 511 or 2047 testing, QRS willl be transmitted in the primary channel and PRBS in the secondary channel. If PRBS is desired to be transmitted simultaneously in both channels (CAUTION!! This may introduce more zeros than allowed by the network.), input a comma (,) and P at the end of your test command string.

3.4 TROUBLESHOOTING

PROBLEM	SOLUTION
Terminal does nothing at all, or prints strange characters.	- Check to see that the terminal's communication parameters are set up to match those listed in section 3.1. - If a modem is used, check the modem's communication parameters as well, and check to see that the proper phone number has been dialed. - Check connections on the serial cable, power cable, and check the power switch.
Command was typed in, but nothing happened.	- Remember to always press the "ENTER" key, or "CARRIAGE RETURN".
The only response I get is a question mark.	- Make sure that the "ALL CAPS" key is activated, and also that the parameters in the command line are separated by commas.

SECTION IV

BATTERY POWER OPTION

4.1 GENERAL DESCRIPTION

The optional battery pack for the Loop Test Unit family of products is used where access to 120 VAC is not available.

The battery pack is located inside the hinged lid of the unit; connnection is made through a cord which is located in the upper right corner of the control panel.

There is a battery charging circuit that is internal to the unit; the battery pack will automatically be charged whenever the unit is plugged in. However, it is strongly recommended that the TPI 90-5 Smart Charger be used periodically to enhance the lifespan of the battery pack.

4.2 BATTERY REMOVAL

Open the vinyl cord storage cover located in unit's lid.

Disconnect the battery pack from the unit by unplugging the connector.

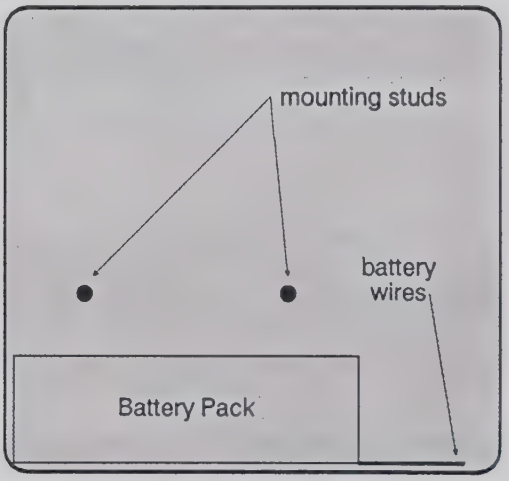
Remove the two knurled nuts that hold the battery mounting bracket in place, and remove the mounting bracket.

The battery pack may now be removed.

4.3 BATTERY INSTALLATION

Open the vinyl cord storage cover located in unit's lid.

Position the battery pack as shown in the diagram below, with the battery in the lower left cornerof the lid, with the wires and connector on the lower right corner of the battery pack



Inside of Loop Test Unit lid,
with battery mounting bracket removed.

Put the battery mounting bracket over the studs in the lid. Push down (toward the battery pack) and fasten the two knurled nuts.

Connect the battery wires to the unit by plugging in the connector.

4.4 OPERATION

A unit with the optional battery pack is used the same as the standard unit. All procedures for testing and control still apply.

When the unit is plugged in, it will operate using 120 VAC, and when it detects the lack of this power source it will automatically switch over to battery power. Whenever the unit is connected to a 120 VAC, it will automatically charge the battery pack.

There are, however, some important points to keep in mind:

- The life of the battery pack is approximately 4 hours.
- When the "LOW BATTERY" LED lights, you have approximately 10 minutes of operating time. After this time period, results will be erratic.
- Periodic use of the TPI 90-5 Smart Charger is strongly recommended. This will serve to enhance the lifespan of the battery pack through deep-cycle charging.

4.5 USING THE TPI 90-5 SMART CHARGER

The TPI 90-5 Smart Charger is periodically used to restore the battery pack to its original capacity. The cycle involved is rather time-consuming; it is recommended that a battery pack is left on the Smart Charger overnight.

The TPI 90-5 Smart Charger may also be used to check the condition of the battery pack. To accomplish this, connect the battery pack to the Smart Charger, and press the "TEST" button. This may be done without removing the battery pack.

If you need to use the unit while the battery pack is connected to the Smart Charger, you will need to install a second battery pack (TPI 90-4) while the first one is charging. Please refer to the previous paragraphs for battery removal and installation. Connect the first battery pack to the Smart Charger, and press the "START" button. An indicator LED on the Smart Charger will light when the charging cycle has been completed.

If you do not need to use the unit during the charging cycle, you do not need to remove the battery pack. Open the vinyl cord storage cover located in the lid, disconnect the battery pack from the unit, and connect the battery pack to the Smart Charger. Press the "START" button on the Smart Charger. An indicator LED on the Smart Charger will light when the charging cycle has been completed.

4.6 SPECIFICATIONS

Battery life	- Approx. 4 hours
Battery life after "BATTERY LOW" LED lights	- Approx. 10 minutes
Charger	- The unit contains an internal charging circuit. - Periodic use of TPI 90-5 Smart Charger is highly recommended to enhance battery lifespan.
Weight	- The battery pack weighs 2 pounds

SECTION V

PRINTING/LOGGING RESULTS

5.1 GENERAL DESCRIPTION

The Model 95_1 Digital Loop Analyzer is compatible with the TPI Model 20 Error Logging Device. The Model 20 ELD is a microprocessor controlled printer that receives error signals via the "ERROR LOGGING" connector located on the right side of the Model 95_1, and documents the error count (bit errors), the number of errored seconds (block errors), and percent error-free seconds for a desired recording interval. Results are time and date stamped.

The purpose of the "ERROR LOGGING" connector is to provide an interface to a printer, specifically the TPI Model 20 ELD, to provide a time of day indication of bit error and errored second occurrence in a hard copy format suitable for circuit history files. This capability will be of special value for tests of longer duration or when testing in an unattended mode.

5.2 SET-UP

Connect the ELD Error Signal Cord to the Model 95$_1$ "ERROR LOGGING" connector located on the right side of the Model 95$_1$.

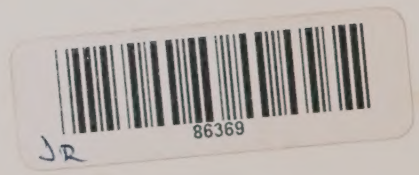
Set-up the Model 20 Error Logging Device per the Operation Manual provided with the unit.

After setting the Model 20 for test duration, time, and date (if necessary), initiate the desired test routine on the Model 95$_1$ Digital Loop Analyzer. Push the START/STOP button on the Model 20 ELD.

The Printer will print the heading, start time, and column headings for the test results, along with a summary of error activity for one minute intervals. (Only during those minutes that have error activity)

Test recording will be concuded either at the end of the test duration time set earlier, or upon manual termination (accomplished by pushing the START/STOP button). The Test Summary will then print the time of test termination, the total Errors and Errored Seconds (provided they do not exceed 9999), and show the percent Error Free Seconds.

Depending on what testing procedures are being executed by the Model 95$_1$, the errors recorded by the printer will represent results from either Primary or Secondary Channel testing, or both.


86369
JR